

XIII. *A Review of the Genus Erebia, based on an Examination of the Male Appendages.* By THOMAS ALGERNON CHAPMAN, M.D., F.E.S.

[Read February 16th, 1898.]

PLATES V—XVI.

THE Erebias have a certain fascination for many of us, not only because they have a very real interest of their own, but because of their association in memory with those excursions amongst the mountains, which we regard with good reason as the most genuine form of holiday and recreation.

Though myself under this influence for many years, it was only recently that I determined to make some endeavour really to understand the various puzzling questions as to the limits of specific forms within the genus, questions upon which no very certain sound emanated from any of our authorities. I hoped also to learn something of the mutual relationships of distinct species, inasmuch as all published lists appear to me to mix up species of different affinities without any obvious method of rational or other classification.

With this object I especially determined to examine the male appendages of all forms that had any claim to specific distinction. I had got well on the way when I found that Mr. Elwes had undertaken a fresh revision of the genus and was making a similar examination of these special structures. Since then, we have in some degree divided the work and compared our results, to such effect, that I believe there is no point of any moment, if indeed any at all, as to which we arrive at different conclusions, though we may vary a little as to our method of presenting them.

I have left to Mr. Elwes all questions of bibliography, nomenclature, description, geographical distribution, &c. for which I am but poorly equipped, and in fact all questions except those arising out of the forms of the male appendages. These questions I have more particularly

worked out, but with so much collaboration and assistance from Mr. Elwes, that he is quite able to accept the conclusions from my work as readily as if he had arrived at them without my assistance; as doubtless, in fact, he would have done had I not relieved him of the necessity of following this line of research more exhaustively. I have to acknowledge the assistance received from him in various ways and from various other friends for specimens and material; of these I may mention Messrs. Nicholson, Tutt, Jones, &c.

I do not propose to discuss the homologies of the organs forming the male genital armature in *Erebia*. They consist of the following portions:—An upper portion, the tegumen (tegmen?) or sicula (uncus and scaphium?), with a central and two lateral processes; two lateral portions, the clasps or valves (combined valvæ and harpes?); a ring of chitin continuous with the tegumen and supporting the clasps; the penis; two chitinous ridges between the ring and the penis on either side.

In *Erebia* as in most other Lepidoptera, it is the clasps (or valves) that present the most distinctive characters in different species, so that in nearly all cases the species may be at once named from its clasp; and this being so, one naturally pays less attention to the other appendages, which with a closer study might probably be found to be equally characteristic.

The tegumen or sicula (why not anglicise this as 'sickle'?) varies comparatively little as regards the central or upper process, which usually has a somewhat regular curve, and a nearly equal diameter throughout; its chief variation is in length and the sharpness or bluntness of the tip. Here dried specimens are apt to be deceptive, from twisting and curling, especially if previously treated too freely with alkaline preparative. The lateral arms are more variable, they almost always have a slight curve and taper to a point, but they may be longer or shorter, more or less sharp, and so forth. In a few instances they are distinctive; thus in *E. athiops* (Group III), viewed laterally, they are seen to be expanded at the end and to terminate obliquely at nearly their full width instead of in a point. In *E. radians* they are of nearly equal width throughout, sweep round in an S-curve and terminate in a rounded end. In *E. disa*, *E. embla* and *E. cyclopius*, they expand at the extremity into a racket-shaped disc, a form to

which there is no approach in any other species. The other parts I have not studied, so I can only say that, in some species at least, they present marked characters.

Since the sickle is so constant in form in *Erebia* and in neighbouring genera presents many considerable variations, one might say from an Erebian stand-point that the sickle presented generic characters, whilst those of the clasp were specific; for in the allied genera we find forms of clasps very like in general outline to those of some *Erebias*. Were we to adopt clasp forms as generic characters, there would be extreme confusion; thus *Erebia aeme*, *Enodia hyperanthus*, *Chionobas brucei* and *C. aello* would be in one genus, *Hipparchia semele*, *Erebia glacialis* and *Chionobas chryxus* in another, and so on. It is, perhaps, not quite correct to say this without noting that, though there is this great similarity of form, there is a recognisable something distinguishing the clasps of the *Erebias*, chiefly perhaps, that throughout the genus, they exhibit a vigour and strength about the spines or styles which is rare in the neighbouring genera.

This circumstance emphasises the necessity of always interpreting the evidence of the appendages with close regard to other characters, and though most valuable for distinguishing separate species, otherwise much alike, it must only be used to unite those as to which such a presumption can be otherwise supported.

Nevertheless it is by no means futile to attempt some sort of classification of the forms of the appendages as an indication of the relationship of the species. Indeed, I think, in most cases the appendages give a more certain indication of alliances than is derivable from wing forms and patterns; because, in *Erebia* the variety in the appendages is of a much less erratic character than it is said to be in many other genera, where close alliance otherwise is often associated with the greatest diversity in the appendages; whilst it also happens that *Erebia* is especially a genus in which colour and marking are very misleading. The case of *E. melas*, in which varieties of two very distinct species (*E. nerine* and *E. glacialis*) were associated as one with a third species, *E. lefebvrei*, itself possibly really a variety of another species (*E. pronoe*), is by no means a solitary instance of confusion that an examination of the clasps corrects.

Some such form of clasp as that of *E. manto* or

E. euryale may be assumed to exhibit the most normally developed type—presenting a base, body or shaft, a lobe or shoulder, and a hind process with a neck and head. This would describe the outline of the clasp, as viewed laterally, or at such an angle as will throw the spinous margin into profile along the edge.

It is perhaps hardly necessary to say anything as to the difficulty in securing the same point of view in comparing different clasps, or in making the necessary allowance for any want of such exact correspondence. Having got over these difficulties myself, I may perhaps not make sufficient allowance for them in presenting the results so as to be clear to others. I have, however, endeavoured to avoid them as far as possible in the rough sketches that I present, so that they will support my statements without explanations as to the aspect shown, &c. These sketches are all taken with the camera lucida and to the same scale.

I have adopted the method of preserving the preparations in balsam, on ordinary microscopic slides, with as little pressure as possible; a method that has several practical advantages, though it is not free from objection.

I have not examined the appendages of every named variety, but have done so in nearly all cases, including all those where there seemed any possibility of specific differences; *E. margarita*, a species founded by Oberthür on a single specimen, and possibly a form of *neoridas*, is the only one I have not seen. In the case of all other species, I have examined material that has fairly satisfied me, in so far that, whilst in several instances I should have desired more and more varied material, I do not think the want of it has led me to any erroneous conclusions. How far, of course, this confidence is justified remains to be proved.

In arranging the species of the genus in accordance with the structure of the clasp, a certain group of species, with a definite clasp form, together with several others probably derived from this one, at any rate, unlike the remainder of the genus, is found to have a neuration differing from the rest; and, as the former species further are almost all of Asiatic and American distribution, whilst the rest are chiefly European, it seems best to divide the genus first into two sections.

SECTION A, the European section, has vein 10 arising from the cell separately; the clasp usually has an obvious, frequently a long, neck.

SECTION B, the Asiatic section, has vein 10 arising from vein 7; in the clasp of one or two species only is any suspicion of a neck present, and it would not be absurd to suspect that the style-bearing surface is the head, and that the shoulder is absorbed into the shaft.

Section A is divisible into seven or eight groups and B into two or three. It is as obvious here as elsewhere that no linear arrangement is satisfactory. By placing certain groups in their most satisfactory linear arrangement, the equally real relationship of other species finds no expression. Thus, as I have arranged the species, the *embla* group is placed after the last and least typical members of the *neoridas* group, whereas its probable alliance is with the earlier forms; if this were expressed, *E. evias* might find a more natural position, *E. neoridas*, *nerine*, *embla* and *evias* being representatives of these allied branches. The latter members of the *neoridas* group would then come into relation with *E. medusa* and the eastern group, with which *E. embla* seems to be in no relation.

The *manto* or *euryale* clasp may be taken as the most pronounced form of clasp in the first group, which contains *E. ligea*, *euryale* and *vidleri* as a first division, and the Grass Erebias as the second. In these there is a gradation from *E. manto* and *eriphyle* with the well-marked typical outline, through forms in which the lobe or shoulder sinks and disappears, to *E. flavofasciata*, in which from base to head the line of styles presents no irregularity. The species are *E. manto*, *eriphyle*, *melampus*, *epiphron*, *pharte*, *arcte*, *christi*, *kefersteini* and *flavofasciata*. The name "Grass Erebias," a name I have heard applied to these species, on what authority I do not know, at first seemed to me rather absurd as all Erebias are grass insects. It is intended no doubt to mark them as not being rock or wood species; at any rate, a name for a group is very desirable if we can get one on any reasonable terms.

These "Grass Erebias" are those that puzzle one in the field, and even in the cabinet perhaps, more than any others. It is therefore very satisfactory to find that the

forms of clasps are quite distinct in all the nine species, and especially that they are most markedly so in precisely those species that are most frequently confused or likely to be so. Thus *eriphyle* is not unlikely to be associated with *melampus* or with *pharte*, and its specific distinctness has even been denied; but the clasp is widely different from that of either of these species, though it somewhat resembles that of *manto*. *Eriphyle* is not likely to be often taken for that species; yet, as a matter of fact, though I took *eriphyle* freely last year in Carinthia, and ought to have known it well enough, I also took it at Innsbrück and at St. Anton, but left the specimens mixed with those of *manto* until an examination of the clasps called my attention to them. Then I found no difficulty in separating them. *E. pharte* and *melampus* are also likely to be confused, and have even been stated to be one species, interbreeding together. The clasp forms are, however, abundantly distinct. Again, *E. epiphron* and *christi* might be confounded, but the clasp forms are very different.

SECTION A.

GROUP I. *a.* The close resemblance of the clasp of *E. manto* to that of *ligea* is extraordinary; and we meet here at the outset the most puzzling question that the appendages afford us throughout the whole genus. I separate *ligea* and *curyale*, on the one hand, from the Grass Erebias on the other, as a subgroup, owing to their general differences; the clasps would place them as almost identical. That they are really closer than their general facies suggests was curiously proved to me by a not at all extraordinary form of *curyale*. All the Erebias have essentially the same fasciæ on the underside of the underwing, but these are marked out in *manto*, notably in the female, in a peculiar manner, by angular, pale patches. In the specimen of *curyale* I allude to, the *manto* markings were quite distinct.

We have to deal with not more, I think, than four forms, viz., *ligea*, *curyale*, *manto* and *cæcilia* (Pyrenees). I am unable to recognise any of these with absolute certainty by the clasps.

The *ligea* group is distinguishable from *E. manto* by the slight but distinct tendency of the lateral pro-

VIII

- radians
- kalmuka
- ocnus
- sibo
- meta
- epispedea
- tristis
- eddä
- turanica
- discoidalis
- tundra
- dabancensis

IX

- parmenio
- afra
- fasciata

Group I

- flavofasciata
- kefesteini
- christi
- epiphron
- melampus
- pharte
- eriphyle
- manto
- caecilia
- vidleri
- lipea
- eurvale

(VIII?)

- II
- mauristius
- ceto
- III
- alomena
- aethiops

IV

- glacialis
- gorgone
- munestra
- ottomana
- tyndarus
- epistygne

VII

- hewitsoni
- medusa

V

- ocine
- lappoona
- stygne
- goante
- nerine
- pronoc
- scipio
- lefebvrei
- zapateri
- margarita
- neuridas

VI

- cycolopus
- disa
- embla
- evias
- rossii

x supposed to be near *eurvale* or *manto*.

- herse
- myops
- hadcs
- maracandica

A CLASSIFICATION OF EREBIAS THROWN INTO THE FORM OF A PHYLOGENY.

cesses of the sickle to broaden out in something of the *æthiops* manner, whilst in *manto* they come to a point. After examining a large number of the *ligea* group, with varieties *adyte*, *ajanensis*, *ocellaris*, &c., I do not feel at all clearer than before as to there being more than one species. The clasps of *ligea*, *adyte* and *ajanensis* (Fig. 1) have a rather bolder shoulder or lobe, marked off both at the neck and towards the base, and those of one or two specimens of *ocellaris* go to the contrary extreme in having very little neck; whilst *euryale* (Fig. 2) usually has a neck similar to *ligea* but the lobe is not definitely marked off towards the base. Still, even *ocellaris* sometimes makes an approach to the *ligea* form, so that it is difficult to avoid a suspicion that the more pronounced character in *ligea* is due to its being usually a larger and better-fed insect.

Without being able to give any very good reason for the belief, beyond an impression gained in the field, I think that the two recognised forms, *ligea*, with its vars. *adyte* and *ajanensis*, and *euryale*, with var. *ocellaris*, whilst usually distinct, are not always so, and in some places intermix. The clasp differences are not great enough to render this otherwise than likely where they occur together on the same ground.

The Swiss form known as *cæcilia* is no doubt *manto*, but the Pyrenean *cæcilia* (Fig. 3) cannot be so easily dismissed. In it the clasp is similar to that of *manto*, with rather more pronounced styles; but there is the essential difference that the lateral processes of the sickle are widened out like those of *ligea*, at least as much as in that species: while this seems to make it impossible for it to be *manto*, it is difficult to regard it as a form of *euryale*. An examination of the other portions of the appendages gives us no further assistance; there is a slight difference in average size, but varieties in each form overlap. I think we must conclude that *cæcilia* (Pyrenees) is not a variety of *manto*, and if it be not a variety of *euryale* it is a distinct species. Were it a variety of *euryale* one would expect to find some trace of the chequered fringes. I place it therefore as a good species and in the first division of Group I.

A new species which Mr. Elwes proposes to describe under the name *vidleri* (Fig. 4), has very much the aspect of a form of *æthiops*, but the clasp prepared by

Mr. Elwes from his single male specimen is very different from that of *æthiops*, having a margin of styles along nearly its whole length and spreading at the head over a considerable surface: it is nearly straight and the open side extends nearly to the head. The most natural place of the species is, therefore, apparently, as a member of the *ligea* group, but related to *ligea* much as, say, *flavofasciata* is to *manto*. I cannot, however, avoid the belief that *vidleri* may prove to be the American representative of *æthiops*, and that some accident has, perchance, attributed to this specimen a substituted clasp.

b. 1. *E. manto* (Fig. 5). I have already discussed the form of clasp in this species. The neck is rather longer and narrower than in *ligea*, and the shoulder drops to it rather suddenly and precipitately, but this is merely a general or average difference not holding good for all specimens. There is also, perhaps, a little more variation in the direction of large and bold styles on the shoulder, interfering with its regular outline, but I could not propose to name with certainty any individual clasp of either species. The sharpness of the lateral process of the sickle in *manto*, compared with the spatulate tendency that it exhibits in *ligea* and *curvale*, can, however, I think, be depended on. *Pyrrhula* is merely a local variety, but its clasp varies rather more than in typical *manto*. An odd specimen (from an old collection), stated to be a Swiss example of *pyrrhula*, and not unlike it, has a very different clasp, more like that of *E. pharte*. It is certainly not *manto*, but I must hope for more material before going further, and only mention it here to call attention to a possibly unrecognised species (Fig. 8, *k*, *l*).

2. *E. eriphyle* (Fig. 6). The clasp has the same general outline as that of *E. manto*, but it is very smooth and regular by comparison, owing to the smallness and uniform size of the styles; and this character suffices to distinguish the species in the many specimens of both that I have examined. A critical distinction, however, may be found in the sickle, the total length in *manto* being 1.88 mm. and in *eriphyle* 1.50 mm., or about as 5 to 4.

The clasp in the remaining species of the group has no very definite lobe or shoulder, but a neck and head are usually definitely marked off from the body or shaft.

3. *E. epiphron* (Fig. 7). The clasp of this species with which *cassiope*, *nelamus* and other named forms agree, has a slight fulness preceding the neck. The neck and head are rather less than a third of the total length of the clasp, the styles being numerous, very small and of tolerably uniform size. In *nelamus* the clasp is slightly shorter and the basal styles more frequently somewhat longer.

4. *E. pharte* (Fig. 8). The commencement of the neck is not very distinct, but the neck and head appear to be about one-fourth of the total length of the clasp. The styles are large and bold, rather rounded than pointed,—indeed several near the base are mere rounded nodules; they may be very few in number, those basal to the neck being, in some specimens, even as few as five or six, in others, as many as sixteen in a double row.

5. *E. melampus* (Fig. 9). There is no lobe; the neck and head are fully two-fifths, sometimes almost half the total length of the clasp, and of fairly uniform diameter. The neck and head have numerous small spines in two rows; on the body there are usually five or six larger sharp spines with two or three small ones in each interval, but there is a good deal of variation in this.

6. *E. arcte* (Fig. 10). The neck with the head is about one-third of the total length of the clasp and has a very regular series of about 8 spines with smaller ones between; on the body are 8 to 12 spines of larger but again of fairly uniform size, and traces of others between.

7. *E. christi* (Fig. 11). Head and neck about a third of the total length: they carry about 8 bold spines, the 4 distal rather the smallest and the 4 proximal sometimes reduced to two; no intermediate spines. The spines on the body are few and often reduced to mere round nodules; the distal ones may be large and bold, though rounded.

8. *E. kefersteini* (Fig. 12). The position of the neck is usually quite obvious. The neck and head carry about 16 styles in two alternating rows, the basal ones being few, one or two to five or six. The styles in

this species are more markedly bent inward into actual hooks than in any other species of this group.

9. *E. flavofasciata* (Fig. 13). The clasps of this species are of much more delicate texture than those of the others of this group, or indeed of any *Erebia*, and are easily bent and twisted: they are also narrower and, when flattened out, form a triangle about half the width at the base of the clasp of *E. pharte* or *arete* similarly examined. The styles, especially those of the neck and head, which are not clearly marked off from the body, are smaller and more delicate than those even of *E. epiphron*. A specimen from the Engadine agrees precisely with those from Campolungo.

GROUP II. In the next group the clasp has no spines on the body or shaft, and the shoulder, instead of occupying about the middle of the shaft, is much nearer the head. The combined shoulder and head have a continuous margin of spines, the neck being a mere depression in this margin. There is a distinct narrowing and bending of the body to the basal side of the shoulder, forming a neck, which, however, is not what I have called the neck in the other groups. (Groups I, IV, V, etc.). This group includes *E. ceto*, and an Asiatic species, having several named forms, which are possibly all one species, certainly not more than two. I doubt there being much real relationship between *E. ceto* and this form, but the clasps are almost identical.

1. *E. ceto* (Fig. 14). This has a longer central process to the sickle than the others, whilst the spinous margin of the clasp is rather shorter and the styles somewhat smaller.

2. *E. maurisius* (= *haberhaueri*) (Fig. 15). This form has a central process of the sickle nearly as long as in *E. ceto*, and the spinous margin of the clasp perhaps a little longer than in *E. pawlowskyi*.

3. *E. pawlowskyi* (= *thela* = *theano*) (Fig. 16). This species has a shorter central process to the sickle. The differences in the clasp are hardly, if at all, appreciable.

I do not know how much value to attach to the length of the sickle in this group; it is possible it may

be little, and that a longer series would break down the distinction. The appearance of the butterflies certainly suggests that they are all the same, unless five distinct species are upheld, which appears inadmissible.

In this Group II, I feel little doubt that *E. ceto* is properly placed, but the remaining form or forms suggest to me certain doubts that must for the present remain unanswered. The forms of the appendages are very close to those of *ceto*; the facies is closely related to *manto*, the peculiar marking of the underside of *manto* being exaggerated and repeated on the upper surface. The neuration is that of the European section. On the other hand the geographical distribution is Asiatico-American, and the forms of the appendages range very fairly with the most typical section of the Asiatic forms (Group VIII). My doubts are not, perhaps, so much as to this being properly placed, but rather as to whether this, rather than the neighbourhood of *medusa*, is not the starting point of the Asiatic section; or, perchance, whether the Asiatic group is not really two distinct groups, one arising at each of these points. A knowledge of the early stages may resolve these questions, especially a knowledge of the forms of the eggs, which are often very distinctive in *Erebias*. My group VIII would in this case be the one arising from group II, and group IX that from group VII.

GROUP III. We pass naturally to the next group, in which the clasp is an exaggeration of that in group II. The body is extremely long and the combined head and lobe very short, about one-fifth of the total length of the clasp (in *E. æthiops*). The side-processes of the tegumen have been already referred to.

1. *E. æthiops* (Fig. 17). The named forms of *æthiops* have appendages differing less from each other than do those of Scotch *æthiops* from the others. The difference is almost entirely one of size, the ratio being as 5 to 6, the Scotch being the smaller. The other named forms are identical with European *æthiops*, e.g., *melusina*, *sedakovii*, a faded-looking *æthiops* from Asia, and the pale *niphonica* from Japan. If any variety is entitled to specific distinction it is that found in Britain. I entertain no doubt they are all one species.

2. *E. alcmena* (Fig. 18). This species, which has been variously treated, and referred to *sedakovii* as a variety, is quite distinct; and, whilst the side-processes of the tegumen and the smallness of the extremity of the clasp place it in this section, the general form of the clasp has considerably greater resemblance to that of the next group. It has the flat, striated, truncate side-processes of the tegumen, very much as in *E. æthiops*; the clasp is quite a fifth shorter than in *æthiops*. The combined lobe and head are less than a fourth of the total length of the clasp. There is a short interval between the lobe and head without styles, which are larger than in *æthiops*, and on the lobe are large enough to suggest the *glacialis* group (IV). There are also some styles on the body or shaft.

GROUP IV. The typical clasp of this group is that of *E. glacialis*, with the great triangular shoulder set at right angles to the very similar head, and the armature of very strong styles. In addition to the more typical *glacialis* and its immediate allies, I think *E. tyndarus* and *epistygne* are more immediately related to this group than to any other; so I place them here, to avoid the multiplication of groups, the only alternative being to make a separate group for each of these.

This group would therefore contain—

a. 1. *mnestra*. 2. *gorgone*. 3. *gorge*. 4. *glacialis*.

b. 1. *tyndarus*. 2. *ottomana*.

c. 1. *epistygne*.

This would not be connected with group I through the two preceding groups, but more immediately, and therefore I place first, as being a more intermediate species than the others:—

a. 1. *E. mnestra* (Fig. 19). In the clasp of this species, the head and shoulder are well separated, though a little approximated as compared with *manto*, and each tends to have much the same outline as the other, though at right angles to it. There are some styles along the side of the lobe, reaching on to the body; these rarely occur in *E. glacialis* or *gorge*, nor are the styles so large and bold as in those species.

2. *E. gorgone* (Fig. 20). This has hitherto been held to be a variety of *gorge*, of which it looks like a

large form; if it is a variety of anything, it is a variety of *E. mnestra*. The clasp does not altogether negative such a hypothesis; indeed, it rather suggests it. *E. gorgone* has a clasp triflingly larger than in *E. mnestra*; the neck is a little longer, but with no approach to the great length in *gorge*. The styles range further along the body, and these styles on the body are stronger than those in *mnestra*; the lobe is narrower and has fewer and much larger styles than in *mnestra*, and therefore looks more long and pointed than in that species. But in all these respects it is separate from *E. mnestra* only in a degree, and that so small, that I should expect to meet with forms very like it indeed in a long series of *mnestra*, these all being points in which *mnestra* is very variable.

3. *E. gorge* (Fig. 21). In *E. gorge* and *glacialis* there are no styles to the basal side of the lobe, and the styles are large. *E. gorge* is smaller, but the lobe and head are proportionally much longer. *E. triopes* is identical.

4. *E. glacialis* (Fig. 22). The clasp is very like that of *E. gorge*, but is much larger and bolder, with shorter lobe and neck.

The average dimensions of these clasps in millimetres are as follows:

	Length of Clasp.	Length of Head and Neck.	Proportion.
<i>Mnestra</i> . . .	1·8	·28	·16
<i>Gorgone</i> . . .	2·1	·44	·21
<i>Gorge</i>	2·5	·84	·34
<i>Glacialis</i> . .	2·8	·8	·28

b. The probable relation of this portion of the group to the preceding is very evident when the clasp of *E. ottomana* is compared with those of division *a*; it is not so apparent when that of *E. tyndarus* is compared, still less so if the American form *callias* is considered. The whole group consists of *E. tyndarus* and its recognised varieties, of which *ottomana* seems to me to merit specific recognition, and the American form *callias* almost to do so.

1. *E. ottomana* (Fig. 23). In this we have a well-developed form that enables us more easily to understand the others. The clasp of *ottomana* may be

described as if it were a member of the *glacialis* group; it has a rather broad body, without styles. The lobe is prominent, triangular, and ends in one very large style. The neck and head are about one-fourth of the clasp in length; in the curve from the lobe to the head are from two to four very large styles, and the head terminates in a bundle of moderate-sized styles.

2. *E. tyndarus* (Fig. 24). This, in its best-developed form, and the one that approaches nearest to *ottomana*, has only three large styles, of which the first probably represents the lobe and is sometimes on a slight eminence, but often so slight that the three styles appear to be seated on a uniform sweep or curve reaching from the base to the head. The head has no styles, but has a rounded termination, carrying a fascicle of strong hairs. Sometimes the first two styles are conjoined. In var. *sibirica* there are only two followed by some very fine teeth. In var. *callias*, the spine representing the lobe is usually recognisable but is close down to the head, which has at its upper margin a number of styles, and below has the same rounded end as in typical *tyndarus*. The amount of variation in both European and American *tyndarus* is so great, and so much bridges over the differences, that I do not think *callias* can be recognised as distinct, but it is certainly very nearly so. *Ottomana* is in a different position, as, besides the pronounced projection of the lobe and the great number of large styles, there is a real structural difference in the presence of the styles at the extremity of the head. It has also not only a much larger, but a proportionally longer central process to the sickle. It is also much larger. The Spanish forms, *hispana* and *pyrenaica*, do not differ from the Central-European forms.

The dimensions and proportions, as given in the last group, are in millimetres as follows:

	Length of Clasp.	Length of Head and Neck.	Proportion.
<i>Tyndarus</i> , Carinthia	1.44	.40	.28
„ Switzerland.	1.44	.20	.14
„ var. <i>sibirica</i>	1.45	.30	.21
„ var. <i>callias</i>	1.40	.10	.07
<i>Ottomana</i>	2.00	.48	.24
<i>Epistygne</i>	2.00	.40	.20

c. E. epistygne (Fig. 25). This species has the processes of the sickle rather short and thick; the clasp resembles that of *tyndarus* in having very few and very large styles. There is often a trace of styles along the body, which does not, I think, occur in the *tyndarus* group. The lobe is represented by one large style, which may have one or more small styles on its sloping sides. There may or may not be a style, if so, a large one, between the lobe and head; the head terminates in from two to four very large porrected styles. Both sickle and styles are large and massive.

GROUP V. This is marked by having the neck much elongated, agreeing in this with the next group, and varying therefore from the *manto* form in precisely the contrary direction to group II and especially group III. The line of descent (or ascent), or, to avoid theory as to which is the central form, the connecting link, is in some such form as *gorge* in group IV. In the present group the neck is not only long but free from styles, whilst there is usually no difficulty in placing the lobe, though it may be reduced and free from styles. In group VI the neck has styles, and the lobe is difficult to locate. I place in this group *a. neoridas, margarita, zapateri*; *b. pronoc scipio, lefebvrei*; *c. nerine, goante, stygne, œme*; *d. lappona*.

a. 1. E. neoridas (Fig. 26). At the threshold of this group we meet a difficulty nearly as great as and of a similar kind to that in group I, viz., the distinction, if any, between the appendages of *E. neoridas* and *E. pronoc*. There is certainly no difficulty in separating the flies, although there is a close resemblance between the patterns of the underside of the hindwings.

The clasps and sickles seem to be identical. There is this difference in the styles of a considerable proportion of specimens, that *neoridas* has the lobe represented by one prominent, large, rather porrected style, with some rather inconsiderable styles, basal to it and at an interval. *Pronoc* rather has this first large style broken down into a little group, and the basal series are rather larger and of similar size and importance to the other group. But the variations certainly overlap. I may easily be wrong, but I think this is one of the instances where the identity (or nearly so) of the appendages does not justify our denying the distinctness of the species.

2. *E. margarita*. I have had no opportunity of examining this form; it is certainly very close to *neoridas*.

3. *E. zapateri* (Fig. 27). This is a derivative of *neoridas*, but is quite distinct. The shoulder, though represented by a prominence, is quite devoid of styles and the neck is extremely slender, and, being as long as in *neoridas*, has the appearance of great length.

b. 1. *E. pronoe* (Fig. 28). When the appendages are so much alike, and when we cannot separate *neoridas* from *pronoe* by them, it may appear presumptuous to say that *E. pitho*, *almangoviae*, &c., are the same as *pronoe*. Still this is, I think, justified, as all these forms are not sufficiently distinct to deserve specific rank, unless it be clearly shown by the appendages to exist; whereas the reverse is the case.

2. *E. scipio* (Fig. 29). This appears to be a derivative of *E. pronoe*; the clasp is rather more massive, and the shoulder is represented by a decided sharp triangular projection ending in a double spine, with further spines along the margin towards the base and, in one specimen, with a few spines along the neck, an exception to the rule in the group.

3. *E. lefebvrei* (Fig. 30). This species appears to be a variant from *E. pronoe*. The clasp is extremely variable in the development of the shoulder and its styles, and some of the forms are quite indistinguishable from those of *pronoe*; others are close to *scipio* in form. In none do the forms go beyond what one might expect to meet with in a long series of *pronoe*.

In his able discussion of *E. melas*, Calberla does not handle this point more than is necessary to show that the Campiglio variety is abundantly distinct from this species, nor does he do much more with *melas* from Eastern Europe.

In doing this, he has done what he set out to do, namely, to prove that *melas* from Campiglio is *E. glacialis*, var. *alecto*; and further than this, he shows that *melas* from Eastern and *melas* from Western Europe are two distinct species and are neither of them *glacialis*.

E. lefebvrei (Western *melas*) is certainly very close to *pronoe*, especially in its clasp forms, but must, I think, be sustained as distinct.

The *pronoe-neoridas* section are then all very closely allied, whether we make them all one species or several. Whilst recognising their close association, I should with my present knowledge sustain *neoridas*, *zapateri*, *pronoe*, *scipio*, *lefebvrei* as good species.

c. 1. *E. nerine* (Fig. 31). In *E. nerine* the shoulder is represented by a single spine, which is sometimes wanting, and thus it is easily distinguished from any member of the *pronoe* group. The Eastern *melas* (true *melas*?) is a form of *nerine*. The clasps figured by Calberla, and those I have examined, are precisely identical with those of *nerine*. That this is here proof of specific identity follows from the fact, that *E. nerine* in its easterly distribution has a well-recognised variety *morula*, of which many specimens are very close to *melas*. A few years ago I took at Cortina a specimen of *E. nerine*, that would be difficult to distinguish from *melas*. This and other dark specimens were, like *melas*, smaller than the *nerine* with which they flew, but with intermediate forms showing their identity. It seems that eastwards *E. nerine* becomes smaller and darker till it presents no normally coloured specimens and is then in fact *melas*.

2. *E. goante* (Fig. 32). This is a very distinct species, the clasp being not unlike that of *nerine*, but broader and more robust seen from above or within; seen laterally, the neck tapers steadily to the head, whilst in *nerine* it preserves its width more nearly throughout. *E. goante* is without any representative of the lobe or shoulder. *E. nerine* usually but not always has a solitary spine or style.

3. *E. stygne* (Fig. 33). In lateral view the clasp is shorter and more robust than that of *E. goante*, narrowing very much just at the neck, expanding very much towards the head and having the terminal style very large.

4. *E. aeme* (Fig. 34). This has a clasp not unlike that of *E. stygne*. If we suppose the neck in *stygne*, instead of expanding again, to continue tapering and to terminate in a single large claw-like style, we should have the form in *aeme*. This clasp with a solitary terminal style is very distinctive, occurring in no other *Erebina*. though forms very close to it occur in other genera,

E. œme may therefore be easily distinguished by this character, a useful fact, since some of its varieties closely resemble other species. I have found it mixed with *E. medusa* and *E. manto*.

5. *E. lappona* (Fig. 35). The clasp hardly looks like, or answers to the description of, those of the leading species of this group—yet it seems to come here most naturally, since it has essentially the same structure, but is so much shortened and broadened as to make it almost as short and squat as that of *E. afra*, which it considerably resembles. It has no recognisable shoulder, the neck is broad and flat, and there is a row of styles at the extremity. Though so broad, it is thin, or at least the neck is, so that, seen laterally, its outline is not unlike that in *E. œme*, and, though so abbreviated, it really possesses the characters of this group.

GROUP VI. This group, except perhaps as regards *E. evias*, is not very close to group V, but it agrees in having a long clasp, with a long neck. This is cylindrical with a terminal cap of styles; the position of the lobe is not very obvious and there is usually an armature of styles stretching along the neck and shaft.

The species here included fall into three divisions, each of which is probably so distinct as to be of equal value with group V. In fact, this group might very properly be made into three groups.

The species are: *a. evias*;
b. rossii (cro);
c. embla, cyclopius, disa.

a. E. evias (Fig. 36). A rather isolated form, in which the typical neuration is for veins 10 and 7 to arise together. This tendency to incline to Section B. probably does not imply any relationship to the forms in that section; the facies of this species is very different, and is much that of group V; besides, the clasp form has nothing approaching it in the whole of Section B, though the large area of numerous styles is not without a suggestion of some species there. The form of the clasp is that of this group or nearly so, but the spines (or styles) are very minute, especially on the head, and extend thence as a broad band, of a number of rows, towards the base, past the position that probably represents the lobe.

b. *E. rossii* (Fig. 37). This is identical with *E. cro.* The clasp is very like that in the following division, but with a remarkable zigzag bend in the middle; it has the head clothed with quite a helmet of spines, as in *E. hewitsonii*. The sickle, however, at once distinguishes it, the side-processes being of the ordinary form. I have had the advantage of seeing the appendages of the type specimen, temporarily in Mr. Elwes' possession.

c. The next three forms are very close together, having very similar clasps and very similar tegumina (sickles) with the lateral processes expanded into racket-shaped ends. So close are they that at first I thought they were probably forms of one species, and I am not certain that that may not ultimately prove to be the case; they are at any rate well-marked local forms, and must for the present at least be regarded as good species.

The upper surface of *E. embla* and *cyclopius* varies to forms that are almost identical; I have not seen forms intermediate as to the lower surface—still *cyclopius* has a pale band, whose outline may be detected in *embla*, where the pale colour has dwindled to two spots. Intermediate forms, and so-called hybrids between *embla* and *disa*, also occur. *E. cyclopius* is unrelated to *E. cdda* or the *Callerebia*, which it much resembles in wing pattern.

1. *E. embla* (Fig. 38). This form has much the longest clasp, as 6 to 5 in *disa* and *cyclopius*, with very large spines which run but a short way along the neck.

2. *E. cyclopius* (Fig. 39). This has a rather shorter clasp, as 5 to 6; the spines are rather smaller and run more than half way to the base.

3. *E. disa* (Fig. 40). This clasp is much like that of *cyclopius*, but is shorter and thicker throughout.

GROUP VII. *E. medusa*, *E. hewitsonii*.

1. *E. medusa* (Fig. 41). In some respects this would come near *E. stygne*, especially in view of the form of clasp found in some German specimens I have. They exhibit a distinct neck, slightly curved, and carrying a rounded head with a circuit of spines. I hardly think these specimens represent a form entitled to specific rank,

but they give the clue to the real nature of the appendages of *medusa*; since in them the resemblance to those of *stygne* is considerable, whilst the ordinary form of clasp in *medusa* is more simple. The open side comes close to the head, which has but a few styles along its upper margin and looks as if it would like to be rid of them; the lower portion of the head is rounded as in *tyndarus*, the whole style being straight. We find, however, that the butterfly has much superficial resemblance to *E. hewitsonii*, and that these two species agree in having Asiatic neuration (10 $\frac{1}{2}$ out of 7) rarely in the male, not unfrequently in the female, and are therefore clearly intermediate between Sections A and B.

2. *E. hewitsonii* (Fig. 42) agrees with *medusa* very much in its facies and also in its neuration. The tegumen is much larger and bolder, as 3 to 2. The clasp has much the same general form, the open side extending close up to the head, which however is much larger, set at a considerable curve to the body and clothed with quite a helmet of large styles. In these respects it resembles the forms found in Section B rather than those of Section A.

SECTION B.

We have already seen that the neuration characteristic of this section occurs in Section A, in *E. evias*, which has probably no relationship with Section B, and in *E. medusa*, which possibly is related to a portion of Section B, and *E. hewitsonii*, which I should have placed in B, but for its apparent connexion with *medusa*.

Some species in Section B have the characteristic venation in no greater degree than *medusa* has, 10 sometimes arising from 7 and sometimes not, whilst in others 10 arises so far along 7 that it can hardly ever be separated from it even in extreme varieties.

I desire, so far as is reasonable, to give especial weight to the indications afforded by the appendages, and therefore perhaps I incline to note the value of neuration when it confirms them, and to neglect it when it does not accord; and so here I do not follow the neuration altogether, but rather the clasp indications. It may therefore be well to give precisely the neurations observed.

In the great mass of the European Section veins 6, 7 and

10, arise abundantly apart from each other. Still in occasional specimens 7 and 10 arise very close together; thus in one specimen of *E. aethiops* and two of *epiphron*, they arise together but immediately separate. In *E. evias* as a rule they arise apparently close together. A specimen of *E. gorge* has 6 rising out of 7, and so forth.

Then in *E. medusa* the majority of examples appear to have 10 well separate from 7, but in not a few 10 arises out of 7, and even some little distance along it.

A similar condition obtains in *E. hewitsonii*, *epispodea*, *sibo* (*oenus*), *radians*, *kalmuka* and *meta*. In these the European neuration is less frequent than in *E. medusa*, and not unfrequently 10 rises a good way along 7. In the female this is much more usually the case, and 6 also often rises out of 7.

In *E. turanica*, *edda*, *tristis*, *dabanensis*, *tundra*, *discoidalis*, *fasciata*, *parmenio*, *afra*, 10 always rises a good way along 7.

Yet by clasp form *E. medusa* is not so near to any of these as they are to each other, and the above from *E. epispodea* to *discoidalis* belong to one group. *E. hewitsonii* and *fasciata*, *E. afra* and *parmenio* are different, each species almost forming a group by itself.

Section B may therefore be divided into two parts by the venation, a division with venation varying between the European and Asiatic type and a division with purely Asiatic venation. It may also be divided into two by possessing the clasps (1) with some resemblance to those of group II. in outline, (2) of other forms.

GROUP VIII. There is a considerable sameness of the clasp form throughout the group, which is thus a very natural one; the variation is from a type generally resembling that of group II, but with little indication of a division of the style-bearing margin into head and lobe, and with this margin occurring as an oblique truncation of the shaft in the lobe region, and the head and neck abbreviated. See remarks under Group II.

1. *E. epispodea* (Fig. 43). The clasp of this species most resembles the form found in group II; the body is curved forwards so that the style-covered margin is parallel to its axis, or nearly so. There is some variation, especially in the size of the styles, which are in several rows.

2. *E. meta* (Fig. 44). This species has rather slender lateral processes to the tegumen. The styles do not end so abruptly upwards as in other species, but pass on to the body, dwindling in size. There are some little differences in the size of the styles and their lateral extension in different specimens, which I have under the names *yssica*, *gertha*, *mopsos*, *alexandra*, but they are not sufficient to warrant definition. I fancy larger series would show such slight differences to be individual to a great extent.

3. *E. sibo* (Fig. 45). This has the lateral processes of the tegumen very short and small, incurved and adpressed, so as to be very inconspicuous. The clasp has a little trace of depression before the tip (site of neck ?); styles of moderate size in several rows.

3 a. *E. ocnus*. It has the same tegumen as *sibo*, which is quite a distinctive one. The styles are rather bolder and the one at the extremity of the clasp is very large. As five preparations of my own, and one or two of Mr. Elwes's preparations, are all I have seen of the two species, I do not like to be positive, but incline to regard the differences observed between *sibo* and *ocnus* as individual variations; I should unite the species, if this is at all in agreement with other indications.

4. *E. kalmuka* (Fig. 46). This species comes nearest to *E. sibo* in the form of the tegumen; the clasp is smaller, with bolder styles in definite alternate rows, the front one incurved. Despite its peculiar facies, both the appendages and neuration show this to be the natural position of the species.

5. *E. radians* (Fig. 47). I have already referred to the cylindrical S-shaped shafts and hemispherical ends of the lateral processes of the tegumen, that distinguish this species. The styles are large and bold, there is a depression in the stylous ridge possibly representing the neck.

6. *E. turanica* (Fig. 48). This very closely resembles *E. meta* especially in the form of the tegumen, and in the styles invading the shaft of the clasp, which is however smaller, more delicate apically and more rounded.

7. *E. edda* (Fig. 49). The central process of the tegumen is rather long; the clasp resembles that of

radians in showing indications of a neck, when seen in profile; but when looked down upon, on the style-bearing surface, it is very broad, especially towards the head, and has seven or eight rows of styles, which are very small towards the head; the stylous ridge is easily twisted in getting into position for observation.

8. *E. tristis* (Fig. 50). One may describe the clasp of this form as having acquired permanently and with much exaggeration a peculiar twist, such as the stylous ridge of *edda* easily falls into in a trifling degree, but so exaggerated as to be almost different in kind, though difficult to describe.

9. *E. dabanensis* (Fig. 51). The tegumen is very large, especially the central process; the clasp has the general form of that of *epispodea*, but is larger and stronger, and with the stylous ridge twice as long. The styles are very large and bold, in several rows, curling over and especially overhanging their base towards the body.

10. *E. tundra* (Fig. 51 *bis*). The facies of this species is very much that of *E. meta*, but it is probably nearer *dabanensis*. In Dr. Standinger's two original specimens the neuration is Asiatic and, especially in the male, 10 arises very far along 7. The appendages in the male specimen happen to be well expanded, and are capable of being examined fairly satisfactorily *in situ*, but cannot be so easily sketched under the camera as if removed; the processes of the tegumen are long, and the lateral ones very sharp and slender. The form of the clasp is almost identical with that of *dabanensis*, but the spines are not so bold and pronounced, nearer in fact to those of *meta*, and are in a double row.

11. *E. discoidalis* (Fig. 52). The central process of the tegumen is large and heavy, not unlike that of *E. hewitsonii*; the stylous surface of the clasp is more terminal and less marginal than in others of this group, and passes round the head, suggesting an alliance with *E. hewitsonii* or *E. fasciata*.

GROUP IX. 1. *E. fasciata* (Fig. 53). This has a very large, broad, rounded clasp, with a heavy armature of large styles surrounding the end. The form of the clasp may perhaps be derived from that of group VIII. by way of

discoidalis, but it has a very special and distinctive aspect, so that its absolute identity in *fasciata*, *erinna*, and *magdalina* leaves no doubt that these are all forms of one species—a conclusion that is not disturbed by any observable differences in them, when once their identity is asserted.

2. *E. parmenio* (Fig. 54). This form has probably little in common with the last species; it has a peculiarly broad square, squat clasp.

3. *E. afra* (Fig. 55). Another short, broad, squat clasp, which is however not of the same character as that of *parmenio*; in outline on lateral view, it is not unlike that of *eme* or *lappona*, and if we could assume Asiatic neuration to be independently acquired, the species might be placed on its clasp form near *lappona*. The great size and length however of the upper process of the tegumen make this hypothesis untenable.

The three species in this group ought perhaps to have been placed each in a separate group, as they have not much in common.

I place by itself *E. myops* (Fig. 56), whose right to be regarded as an *Erebia* I disallow. The form of the tegumen suggests an alliance with *Cænonymphea*.

Another group that are not *Erebia*s but are well on the way to *Callerebia*, are *maracandica* (Fig. 57), *jordana* (Fig. 58), *hades* (Fig. 59) and one or two other named forms. Their appendages are more like those of *Callerebia* than of *Erebia*, and their facies is different.

Herse (Fig. 60) is another species, with a very remarkable clasp form, that seems not to be an *Erebia*.

By showing the identity of *erinna*, *fasciata*, and *magdalena*, there is demonstrated a parallel to the case of *glacialis* even closer than that which the similarity of *magdalena* in so many respects to var. *pluto*, had led Mr. Elwes and others to draw. In showing also the identity of *melas* with *nerine*, and the close relationship though probably not specific identity of *pronoe* and *lefebvrei*, I enlarge the number of examples in which geographical isolation has had the effect of establishing very marked varieties or incipient species, varieties that often differ more than distinct species do; yet, geographical isolation only having operated, the form of the appendages remain unchanged and the species may remain

undivided whilst in other cases the divergence has reached specific distinction.

Perhaps the best known example of this is *E. glacialis*, which in its varied forms of *alecto*, *pluto*, *nicholli*, has been regarded as forming several distinct species, but is now accepted as being really only one variable species—a conclusion fully borne out by the identity of the appendages in all the forms, and probably more readily accepted as the geographical area it inhabits is not a very wide one.

As being perhaps at the other end of the series, in so far as the extreme forms are entitled to, and will doubtless be accorded, specific rank, we may take the group of *E. neoridas*, *margarita*, *zapateri*; *margarita* I have not had the opportunity of examining, but *neoridas* and *zapateri* are obviously very closely allied, and the appendages show that *zapateri*, though quite a distinct form, is very close indeed to *neoridas*.

These two instances, perhaps the most familiar, and also the most extreme as regards the identity or distinctness of the forms composing them, are not by any means the most typical and remarkable, in as much as their component elements are not very widely separated geographically.

The *athiope* group consists of *E. athiope*, inhabiting Europe, *E. sedakovii*, Asia, and *E. nipponica*, Japan. The close resemblance of these three and other named forms and the identity of their appendages, compel one to the conclusion that they are geographical varieties not entitled to specific rank.

Perhaps the most interesting species in this connexion is *E. fasciata* from Asia, which is identical specifically with *erinna* from Asia and *magdalina* from Colorado. Their appendages differ *toto cælo* from those of *glacialis*, as does the neuration, yet *magdalina* in appearance (and Mr. Elwes tells me in habits and habitat also) might be mistaken for *glacialis*, var. *pluto*, and *erinna* for *glacialis*, type.

E. nerine is of much interest, being modified into a small dark variety which has been called *morula*, in its more eastern range, and still further south and east recognised as a distinct species under the name of *melas*.

We may contrast with these the *manto*, or grass Erebiar group, consisting of nine species, of which eight all occur

on the Alps of Central Europe, and, except one or two species in the Pyrenees, have no wider range. Two, three, or more of the species are often, indeed usually, associated on the same ground; yet, in spite of what has been advanced as to their crossing and presenting intermediate forms, the evidence of the clasps is quite to the contrary, especially since the species said to be mixed are those that are most distinct. But all these species are sufficiently closely allied to lead us to conclude that they have a common origin; and they therefore compel us to accept in explanation Romanes's theory of physiological isolation to account for their origin and preservation as distinct species. We have then in the grass *Erebias* a number of very similar and associated forms with very definitely distinct appendages; whilst in the other series of species, when geographical isolation has been chiefly at work, we have slightly different forms with identical appendages that compel us to regard them as one species.

We further find that many species have dark or black forms:—*glacialis, pluto; fasciata, magdalina; ncrine, melas; manto, cæcilia*; whilst *ceme, mnestra, epiphron, stygne*, and others have forms making a very close approach to these. *E. lefebvrei* has its coloured and dark forms, and *E. cæcilia* from the Pyrenees, which appears to require a fresh name, is the only dark form not correlated with a normal coloured type.

EXPLANATION OF PLATES V—XVI.‡

The figures are all sketched under the camera lucida, the amplification being 16 diameters.

Allowing for some roughness in the sketches, the general form of the processes of the tegumen and of the clasps, and the arrangement of the spines or styles are quite accurate.

The view of the clasps is usually lateral, but in some instances a more vertical aspect is given, to illustrate the form of the clasp. In a few cases the clasps are flattened by pressure, so that they look broader than they actually are. This gives, however, a more accurate single view of the form of the chitin, but many clasps do not admit of it.